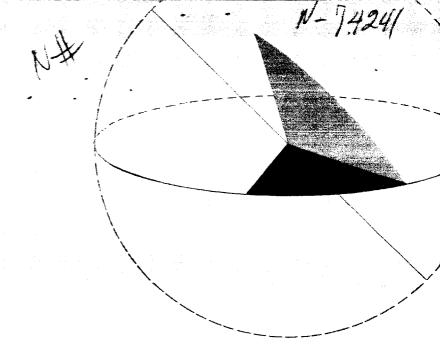
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THE FIRST FLIGHT OF A MAN
INTO COSMIC SPACE



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THE FIRST FLIGHT OF A MAN

INTO COSMIC SPACE PRAVDA, April 25, 1961

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JET PROPULSION LABORATORY
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On April 12, 1961, the Soviet Union has accomplished the flight of a man into cosmic space for the first time in history. The spaceship "Vostok," with the pilot-cosmonaut Youri A. Gagarin aboard, was placed in a satellite orbit around the Earth. The weight of the spaceship-satellite, excluding the last stage of the carrier rocket, was 4,725 kg. According to corrected data which was obtained on the basis of processing of all measurements, the perigee was 181 km, the apogee was 327 km, and the orbital inclination was 64°57'.

After completing its flight in orbit, the spaceship-satellite landed safely at a preselected area of our country.

The first cosmic flight of a Soviet man opens an era of man's direct penetration into cosmic space, and it is one of the most important events in the history of civilization. The realization of this flight is the result of completing a large purposeful program on the conquest of cosmic space which was conducted in the Soviet Union.

The great dream of the founder of cosmic flights, K. E. Tsiolkovsky, came true. Tsiolkovsky said: "Mankind will not remain forever on Earth, but in search for light and space it will in the beginning barely penetrate beyond the realms of our atmosphere and then it will conquer the entire solar system."

A DECISIVE STEP TOWARD THE CONQUEST OF COSMIC SPACE

During many thousands of years, the inquisitive mind of man tried to penetrate the depths of the universe. This is a result of the yearnings of man to learn and to discover his place in the universe as well as to learn how to control the laws of nature.

Contemporary science has at its disposition a huge arsenal of methods for the study of cosmos. Distances which are already accessible by these means are expressed in astronomical figures.

Cosmos is the world of stars, astral associations, and galaxies in which our solar system is located. Advanced science, which is equipped with the studies of dialectic materialism, confirms the existence of a multitude of worlds, in which the development of a higher form of life is possible. The origin of life in the universe is by no means excluded. One should not assert at the present time where and in what form life exists outside of our solar system, but one thing is certain, life does exist.

With the appearance of man on the Earth, a qualitatively new stage in the development of the Earth as a planet began. Learning the laws of nature, men began to change the face of the Earth, arming himself with powerful weapons for the struggle against nature. From the first stone axe, men progressed toward the completion of the greatest achievement—the first flight into cosmic space.

By carrying out flights into cosmic space, men will penetrate directly into an area entirely new to them. Any penetration into a new area carries with it unpredictable new discoveries. The flights of the first artificial Earth satellites have already made possible the discovery of the existence of radiation belts around the Earth, which has essentially changed our ideas about the atmosphere and the radiation danger during cosmic flights.

It is quite difficult to evaluate completely at the present time the values and all the potentials of cosmic flight. There is no doubt about one point, and that is—the penetration of space by man will immensely extend the boundaries of our knowledge and will enrich science and culture.

The tempo of development of science and technology in our time is increasing with each year. We are witnessing today achievements which could not have been imagined even 15 to 20 years ago. There is no doubt that the further development of science and technique, and particularly the technique of cosmic flights, will take place at a more rapid pace.

It should be anticipated that, in the very near future, cosmic instruments will be utilized for the solution of a number of practical problems. Meteorological service and ice research, the relay of television and radio transmissions, the carrying out of the most extensive scientific investigations outside of the Earth's atmosphere, these are only the first steps on this road. These steps will be followed by manned flights to the Moon and other planets of the solar system, the creation of orbiting interplanetary stations, the gradual adaptation of man to life in space. In the distant future, communication with distant worlds can be foreseen, which at the present time seems to be only science fiction imaginings.

Among the great number of scientific technical problems which were put before Soviet scientists and designers during the preparation and accomplishment of a manned flight into space, one of the principal problems was to secure the necessary conditions for a safe flight of a man and his return to Earth. For the solution of this scientific technical problem, it was necessary to conduct a great number of construction tests and experimental launchings.

During the examination of possible variations for the first manned flight, it was decided that the most purposeful way to accomplish this would be by the utilization of a spaceship-satellite, since such a flight opens to man the road directly into cosmos. A flight along a ballistic trajectory aboard the rocket, which is essentially

not a cosmic flight but basically only a sensational spectacle, was disregarded. It is therefore, not by accident that Soviet scientists and designers have, from the very beginning, directed all their efforts towards the creation of artificial satellites and cosmic ships of large weights and dimensions. This was the principal approach for the development of cosmic flights in the USSR. Only in this way could the historical manned flight into cosmic space have been accomplished.

Beginning with <u>Sputnik II</u>, which carried an experimental animal aboard, the dog Laika, and up to the spaceship-satellite "Vostok", Soviet scientists and designers have followed this road without any deviations.

It was necessary to obtain as much information as possible on the operation of the structure of the cosmic ships, their instrumentation, and to check the reliability of control for the various systems during the flight. A principal new problem was the creation of a system for the orientation of cosmic spaceship-satellites and the solution of the problem of the ship's return to Earth.

For the flight of a man aboard a spaceship, it was also necessary to secure the maintenance of normal pressure, temperature, the contents of air and other conditions necessary to the life activity of a man.

The carrying out of scientific investigations of cosmic space along with the solution of principal problems of the physics of cosmos yielded the necessary information on the effects of various radiations on live organisms during conditions of cosmic flight and also the meteorite danger during the flight. On the basis of the data obtained, steps were taken to protect the spaceship-satellites from radiation.

A great amount of experimental material which was obtained as a result of the flights of the first Soviet spaceship-satellites and the development of a system for

securing a successful return of the spaceship to Earth, made it possible for Soviet scientists and designers to start the construction of a spaceship for a manned flight into space. As a result of a great and intensive operation, the spaceship "Vostok" was created. In March, 1961, the two final controlled test launchings of this spaceship were conducted. During these launchings the cosmonaut's chair was occupied by a mannequin. In addition, the experimental animals Chernushka and Zvevdochka were present in this cabin.

These flights were accomplished in accordance with the same program by which the first manned flight into space was to take place. Both flights corresponded very closely with the assigned program and confirmed the high reliability of the construction and all systems of the spaceship.

A thorough preliminary testing of the spaceship-satellite "Vostok" assured a complete success during its very first launching with a cosmonaut aboard, which took place on April 12, 1961.

THE STRUCTURE OF THE COSMIC SHIP "VOSTOK"

The cosmic ship "Vostok" was developed on the basis of the experience which was obtained during the launchings of the first Soviet spaceship-satellites.

The spaceship-satellite consists of two basic parts:

- 1. The pilot's cabin, or cockpit, which houses the cosmonaut, equipment which assures active life, and the landing system;
- An instrument section which is designed for housing all instruments which are in operation during the flight in orbit and the braking motor installation of the spaceship.

After achieving its orbit, the spaceship-satellite is separated from the last stage of the carrier rocket. During its flight, the spaceship's instruments operate in accordance with a determined program, which assures orbital parameter measurements, transmission to Earth of telemetry information and television images of the cosmonaut, a two-way radio communication with the Earth, maintenance of the desired temperature regime aboard the spaceship, and air conditioning inside the pilot's cabin. The operation of the instruments is controlled automatically with the help of a special programming device aboard the spaceship and, during emergencies, by the pilot-cosmonaut himself.

The program for the first manned flight into space called for only one orbit around the Earth. However, the construction and equipment of the spaceship-satellite permits the accomplishment of more extended flights.

After completing the flight program, before landing, a special system carries out the orientation of the spaceship in a determined direction. Then, at a preselected point on the orbit, the braking motor installation is activated, and, as a result, the spaceship's velocity is decreased to a precalculated magnitude. As a result of these activities, the spaceship-satellite enters a descent trajectory.

The cosmonaut's cabin is slowed down in the atmosphere. The descent trajectory is selected in such a manner that the gravitation during the spaceship's entrance into the dense layers of the atmosphere does not exceed the maximum gravitation force tolerable for man. After the spaceship's cabin comes down to the desired altitude, the landing system is activated. The direct landing of the pilot's cabin takes place at low speed. From the moment of activation of the braking motor

installation to the moment of landing, the spaceship travels about 8,000 km. The duration of flight along the descent sector is approximately 30 min.

The external surface of the pilot's cabin is covered with a heat-protection layer which eliminates the danger of burning up during re-entry through the dense layers of the atmosphere.

Three illuminators and two rapidly opening portholes are built into the casing of the cabin. The illuminators are equipped with heat-resistant glass and permit the cosmonaut to make observations during the duration of flight.

Inside the spaceship-satellite, the cosmonaut occupies an ejection seat which is also his working place during the flight; it is designed to serve as an escape mechanism for the cosmonaut in case of necessity. The chair is installed in such a manner that the g-forces during the acceleration portion and during the re-entry, will act on the cosmonaut in the most favorable directions (chest-back).

During his first flight, the pilot-cosmonaut was clothed in a protective suit, which assured his safety and work ability even in the event a leak should develop in the hermetically sealed cabin of the spaceship.

The spaceship-satellite also carried the following:

- 1. Instruments and equipment necessary for the protection of active life of a man's organism (an air-conditioning system, a system for the regulation of pressure, food and water, a system which assured the elimination of products of a man's physiological activities);
- 2. Instruments for flight control and a system for manual guidance of the spaceship (pilots panel, instrument panel, block for manual control, etc):
- 3. A landing system;

- 4. Radio equipment for communication between the cosmonaut and Earth;
- 5. A system for independent registration of data on the operation of the instruments, radio telemetry systems, and various indicators;
- 6. A television system for the purpose of observation of the cosmonaut from Earth;
- 7. An apparatus for the registration of physiological functions of the man;
- 8. A braking motor installation of the spaceship:
- 9. An orientation-system apparatus;
- 10. Flight-guidance instruments;
- 11. Radio systems for measurements of orbital parameters;
- 12. A thermo regulation system;
- 13. Power sources.

On the external surface of the spaceship steering organs, orientation elements, shutters of the system of thermo regulation, and antennas of the radio system were installed.

The pilot's cabin aboard the spaceship-satellite is much more spacious than an airplane cockpit. The equipment of the cabin is arranged with the consideration of convenience for the activity of the cosmonaut during the flight. When sitting in his chair, the cosmonaut can carry out all necessary operations connected with observations, communication with Earth, flight control, and, when necessary, guidance of the spaceship.

In the body of the pilot's chair are installed the following:

- A separation button with an auxiliary system for the fixation of the pilot's body during ejection and descent by parachute if necessary;
- 2. A parachute system;

- 3. Ejection and pyrotechnical installation;
- An emergency kit (food, water, and supplies) and a radio communicator for communications and direction finding which can be used by the cosmonaut in case of a forced landing;
- 5. A ventilation system for the pilot's suit and a parachute oxygen device;
- 6. Automation for the pilot's chair.

The pilot can land while remaining inside the cabin of the spaceship. Such a landing method was tested during the flight of the fourth and fifth Soviet spaceship-satellites during which experimental animals were present inside the cabin. A landing method is also provided with the ejection chair carrying the cosmonaut from the cabin at an altitude of about 7 km and a resulting landing by parachute. This method was also tested during the launchings of spaceship-satellites.

The air-conditioning system which was installed aboard the spaceship-satellite maintained inside the pilot's cabin a normal pressure, normal concentration of oxygen by a concentration of carbon dioxide gas which did not exceed 1%, a temperature on the level of 15 to 22°C, and a corresponding humidity within the limits of 30 to 70%. The regeneration of the air composition, the absorption of carbon dioxide gas and water vapors with a discharge of the corresponding amount of oxygen, is accomplished by the utilization of highly active chemical compounds. The regeneration process is regulated automatically. During the decrease of the amount of oxygen and the increase of the concentration of carbon dioxide gas, a special indicator emits a signal in response to which the executive mechanism changes the mode of operation of the regenerator. During an excess discharge of oxygen an automatic operation of the

executive mechanism takes place, which leads to a decrease in the discharge of oxygen into the atmosphere of the cabin. The regulation of humidity in the air is also carried out analogously.

In the case of contamination of air by harmful admixtures which are produced by the discharge during man's physiological functions and the operation of the instruments, a purification is provided by special filters.

The maintenance of the desired temperature limits during the flight aboard the spaceship is accomplished with a system of thermal regulation. Its most outstanding property is the utilization, for the purpose of eliminating excess heat from the cabin occupied by the pilot, of a liquid cooling agent, the temperature of which is maintained at a constant level.

The cooling agent progresses from a system of thermo regulation into a liquid-air radiator. The air consumption through the radiator is automatically regulated depending on the temperature in the descending ship. Thus, the desired temperature limit inside the cabin is maintained with great accuracy.

For the purpose of maintaining a stable temperature of the cooling agents and securing the required temperature limit in the instrument section, its external surface is equipped with a radiation heat converter and a shutter system which is also controlled automatically.

For the purpose of landing at a preselected area, the spaceship-satellite should be properly oriented in space before the braking motor installation is activated. This problem is solved by a system of orientation. During this given flight, the orientation was accomplished by one of the spaceship's axes in the direction of the Sun. The sensitive elements of this system are a number of optical gyroscopic

instruments. Signals from these instruments are converted into commands in the electronic block, and, in response to these commands, the steering mechanisms are activated. The orientation system provides automatic Sun seeking, the proper turning of the ship, and accurate locking-in of the ship in the required position.

After the spaceship is oriented the braking motor installation of the spaceship is activated at the proper time. The command for the activation of the orientation system, the braking motor installation, and other systems are given by the electronic programming installation.

For the measurement of the orbital parameters of the spaceship-satellite and the control of the operation of its instruments, a radio-measuring and radio-telemetry apparatus is installed. The measurement of flight parameters of the spaceship and the reception of telemetry information during its flight is carried out by ground stations which are distributed along the territory of the USSR. Measurement data are automatically fed over communication lines into computation centers, where their processing is carried out on electronic computers. As a result, information is obtained operatively during the flight on the basic parameters of the orbit, and a prognosis can be made on the further flight of the spaceship.

The radio system "Signal" installed aboard the spaceship operates on the frequency of 19.995 mc, and serves as a direction finder for the ship and for the transmission of bits of telemetry information.

The television system transmits images of the cosmonaut to Earth, which makes it possible to carry on a visual observation of his condition. One TV camera transmits full-face images of the pilot and another camera shows the pilot in profile.

A two-way communication between the cosmonaut and Earth is secured by a radio-telephone system which operates in a shortwave range (9.019 and 20.006 mc) and an ultra-shortwave frequency (143.625 mc).

The ultra-shortwave channel was utilized for communication with ground stations at distances from 1,500 to 2,000 km. Communication over shortwave channels with ground stations which are located on the territory of the USSR can be carried on during a large part of the orbit, as was proven by experience.

The radio-telephone system also contains a tape recorder which records the cosmonaut's voice during the flight so that it can be played back and transmitted to Earth when the spaceship is passing over the ground-receiving stations. A radio telegraph transmission is also provided for the cosmonaut aboard the spaceship.

The instrument panel installed aboard the spaceship and the pilot's panel are designed for the control of the operation of the basic systems aboard the spaceship and for assuring, in case of necessity, the return of the spaceship by utilizing the manual-guidance system. The instrument panel contains a number of arrow indicators and signal plates, an electric clock, and also a globe, the rotation of which is synchronized with the motion of the spaceship along its orbit. The globe permits the cosmonaut to determine the position of the spaceship. A handle and a switch located on the pilot's panel control the operation of the radio-telephone system, regulation of the temperature inside the cabin, and also the activation of the manual control and the braking motor.

During the construction of the spaceship special attention was given to the provision of utmost safety for the pilot. The launchings of the first Soviet spaceship-satellite have confirmed the high reliability in the operation of the instruments and

equipment. However, on the spaceship "Vostok" a number of additional safety measures were taken in order to exclude any possible unfortunate accidents and to guarantee a safe flight for the cosmonaut. This complied fully with the basic problem, which was to construct a spaceship which would permit a man to penetrate safely into cosmic space.

For the purpose of the spaceships orientation in the case of manual control, the cosmonaut will utilize the optical orientator which permits him to determine the position of the spaceship in relation to the Earth. The optical orientator is installed on one of the illuminators of the pilot's cabin. The orientator consists of two circular mirror reflectors, a light filter and a glass with a reticle. Rays from the line of the horizon fall on the first reflector and then pass through the glass of the illuminator and fall on the second reflector which directs them through the reticle to the eye of the cosmonaut. During a correct orientation of the spaceship in relation to the vertical, the cosmonaut can see in his field of vision the image of the horizon in the form of a ring.

Through the central part of the illuminator the cosmonaut can observe the section of the Earth's surface which is directly beneath him. The position of the lengthwise axis of the spaceship in relation to the direction of flight is determined by observing the "run" of the Earth's surface in the field of vision of the orientator.

By activating the steering organs, the cosmonaut can turn the spaceship around in such a manner that the line of the horizon will be visible in the orientator in the form of a concentric ring and the direction of the "run" of the Earth's surface will coincide with the course chart of the screen. This will testify to the correct orientation of the spaceship. In case of necessity, the field of vision of the orientator can be covered up with a light filter or a curtain.

The globe which is installed on the instrument panel, makes it possible to determine, in addition to the current position of the spaceship, the place of landing by activating the braking motor at a given time.

Finally, because of its natural braking in the atmosphere, the construction of the spaceship permits him to carry out a landing on Earth even in the event the braking motor installation fails.

Supplies of food, water, regeneration matter, and the capacity of sources of electrical current are calculated for a flight lasting up to ten days.

In the construction of the spaceship, means were provided which will prevent the temperature inside the cabin to rise above the determined limits during the extended heating of its surface which occurs at the time of the gradual braking of the spaceship in the atmosphere.

MEDICAL-BIOLOGICAL PROBLEMS OF A MANNED FLIGHT INTO COSMIC SPACE

For the solution of the problem on the possibility of a manned flight into cosmic space and his medical security it was necessary to do the following:

- Study the effect of factors of cosmic flight on a organism, and also investigate the
 possible forms and methods of protection from the unfavorable influence of these
 factors.
- 2. Develop the most effective methods for securing normal conditions of life activity of a man in the cabin of a spaceship.

3. Develop methods for medical selection and training of members of a spaceship crew, and also develop a system of continuous medical control over the condition of health and work capability of the pilot during all portions of the flight.

Each of the above-mentioned problems contained a great number of specific assignments on the study and solution of which intensive work was conducted for a period of 10 years by specialists in the field of physiology, hygiene, psychology, biology, and clinical and professional medicine. Investigations were conducted in Earth-laboratory conditions and during flights of animals aboard rockets. Vast experiences which were accumulated in applied fields of physiology and medicine, particularly in aviation medicine and in medical provisions for skin diving and submarine activities, were utilized. Wherever it was possible, special ground stands were set up which permitted investigations under laboratory conditions, of the effects of factors which can be encountered during a cosmic flight. The effects of g-forces and the endurance of organisms to these forces were studied with the help of centrifuges. Acceleration was imitated on centrifuges, which is analogous to the acceleration during the starting sector of the spaceship or during its return to Earth.

With the help of vibrators, heat and vacuum chambers, and other installations, the effects of other factors on an organism were investigated. However, laboratory experience, as a rule, can give results only in regard to the effects on an organism of one given factor at a time from among the above-mentioned, whereas, during an actual flight aboard the rocket, these factors act in a combined form and simultaneously. In addition, under laboratory conditions it was impossible to study the behavior of live organisms in conditions of weightlessness. Therefore, a sensible approach to the

study of the effects of conditions of cosmic flights on organisms was the carrying out of biological investigations with rockets, which began in 1951.

Several dozen experiments with animals aboard rocket flights were conducted up to altitudes of 450 km. As a result of these investigations, broad scientific material was obtained which characterized the reaction of physiological systems and the behavior of animals (dogs, rabbits, rats, and mice) at various flight phases. A thorough investigation of experimental animals during the flight, as well as during a long period after their return to Earth, has permitted us to conclude that the flight conditions aboard rockets through the upper layers of the atmosphere can be withstood by live organisms completely satisfactorily. Changes which were noticed in separate physiological functions during the flight did not carry any ill effects; they often disappeared even during the process of the experiment and no after-effects were discovered later on.

However, due to the fact that rocket flights are very short, we did not succeed in investigating the biological effects of such important factors of cosmic flight as extended weightlessness and cosmic radiation. This is why the possibility of utilizing, for biological experiments, artificial Earth satellites, which began in 1957, was an extremely important step forward.

The first such experiment was made with the second Soviet artificial Earth satellite. This experiment not only confirmed and broadened the data of previous biological tests with rockets, but also succeeded in proving that an extended condition of weightlessness in itself does not distort the basic processes of life activity.

Biological experiments were continued with the first Soviet spaceshipsatellites. The program of these medical biological investigations also included a number of new problems. It seemed to be important, in spite of the additional and deeper study of the effects on an organism of extended weightlessness, and the transition from weightlessness to gravitation and vice versa, also to investigate more thoroughly the biological effects of cosmic radiation. An important section of the program was also the investigation of the characteristics of operation and the effectiveness of the system which in future flights should have secured normal conditions for active life of a man and to guarantee his safe return to Earth. For the purpose of realizing the assigned program, the first Soviet spaceship-satellite carried a variety of specimens of organic life, beginning with the most simple forms of life and extending to higher vertebrates.

The utilization of various types of animals and plants during these experiments has permitted particularly complete and detailed study of the effects of conditions of cosmic flight under most variable processes and functions of organisms. The information obtained on the behavior and condition of the physiological functions of experimental animals was very extensive, particularly on dogs during the flight period.

Observation of the behavior of animals was accomplished with the help of special television systems. An analysis of the obtained data has shown that not only did the animals completely preserve their active life in conditions of extended effects of weightlessness and the following effects of g-forces, but also no ill effects on their basic physiological functions were detected. Also, sufficiently long and thorough investigation of the animals after the flight did not disclose any deviations from normal.

Very serious attention was paid to the possible discovery of any effects from the influence of cosmic radiation during flights aboard spaceship-satellites. Numerous methods which were utilized for solving this problem did not disclose any changes which could have been ascribed to ionizing radiation.

These results of medical-biological investigations aboard spaceship-satellites have made it possible to draw some very important and reliable conclusions. It was recognized that flights aboard spaceship-satellites along an orbit, which was conscientiously selected below the near-Earth radiation belts, are safe for highly developed representatives of the animal world. The results of biological experiments were utilized for the solution to the problem on the endurability of flight conditions by a man.

On this basis, and also taking into consideration the results of laboratory investigations, we came to the conclusion that a manned flight into space is possible without any harm to the health of the man.

PREPARATION OF THE COSMONAUT

The first cosmic flight could have been undertaken only by a man who, after realizing the huge responsibility of the assignment placed before him, would conscientiously and voluntarily agree to give all his knowledge and power, and also possibly his life, in order to carry out this outstanding achievement. Thousands of Soviet citizens, patriots of their motherland, of various ages and professions, have expressed their wish to complete a flight into cosmic space. Soviet scientists received the assignment for a scientifically based selection of the first cosmonauts from that great number of volunteers.

During a cosmic flight, a man will encounter the effects and entire complex of factors of the external environment (acceleration, weightlessness, etc.), considerable

nervous emotional tensions, which would require a man to mobilize all his morale and physical forces. A cosmonaut should thereby preserve a high work capability, an intelligent orientation in the complicated condition of flight, and, in case of necessity, he should be able to participate in the guidance of the spaceship. All this has placed high requirements on the state of health of a cosmonaut, his psychological qualities, and the level of his general and technical preparation.

These qualities coincide most closely with the profession of a pilot. The activity of a pilot determines the stability of his nervous emotional sphere, and his quality of strong will, and this is particularly important for the first cosmic pilots. Then, the category of people participating in such flights undoubtedly should and must be considerably enlarged.

During the selection of the group of cosmonauts, numerous interviews were conducted with a great number of pilots who expressed their wish to participate in cosmic flight. The pilots who were most prepared for such a task underwent a thorough physical and psychological investigation. The purpose of such an investigation was: to determine the condition of health, to disclose any hidden deficiences or a decrease in the stability of their organism towards separate factors which are characteristic of the forthcoming flight, and to evaluate the reaction of man under the influence of these factors.

Investigations were conducted with the utilization of a number of contemporary biochemical, physiological, electrophysiological, and psychological methods and special functional tests which have permitted the evaluation of the reserve possibilities

of basic physiological systems of the organisms (tests in a baro chamber by a rarification of air to a considerable extent during a drop of barometric pressure, and inhalation of oxygen during increased pressure, centrifuge tests, etc.).

An important stage was the psychological investigation, which was directed toward the discovery of people who possess the best memory, imagination, active and easily changing attention, and capability for quick execution of well-coordinated movements.

As a result of the clinical physiological investigations, a group was formed which immediately proceeded toward the accomplishment of the program of special training on special installations and training devices which imitated in ground and flight conditions the factors of a cosmic flight. At the same time, the individual characteristics of reaction of an organism to the effects of imitated factors were determined.

The programs for special training were calculated to familiarize the cosmonaut with the necessary knowledge on the basic theoretical problems which are connected with the assignment of the forthcoming flight, and also with the utilization of equipment and instruments in the cabin of a spaceship. This program provided for the study of the basic rocket and cosmic techniques, the construction of a cosmic ship, special problems of astronomy, geophysics, and basic cosmic medicine.

A complex of special trainings and tests included:

Flights aboard airplanes in conditions of weightlessness;

Training inside a mock-up cabin of a spaceship and on special stands;

Extended presence in special sound-proof chambers;

Training on a centrifuge;

Parachute jumps from airplanes.

In the process of completing this special training certain problems were also solved which dealt with the security of a cosmic flight of a man, particularly problems connected with feeding the cosmonauts during the flight, his clothing, and the air-regeneration system.

During flights aboard airplanes, individual reactions of cosmonauts to the effects of weightlessness and transition from weightlessness to gravitation were investigated. The possibility of carrying on radio communication, eating and drinking, etc., was also studied. This type of test has yielded an answer to a number of important questions on the possible activities of a man under conditions of cosmic flights.

It was established that all selected cosmonauts endured the state of weightlessness very well. In addition, it was proven that, in conditions of weightlessness
which lasted up to 40 seconds, a normal acceptance by man of liquid, semi-liquid and
solid foods is possible. The execution of fine coordinated acts (writing, intentional
hand motions, etc.), carrying on of radio communications, reading, and also visual
orientation in space, is possible.

Training inside a mock-up cabin of a spaceship and on a special training stand was conducted for the purpose of studying the equipment and instrumentation of the cabin, checking the variants of the flight assignment, adaptation toward the presence in a real cabin of a spaceship, etc. For this purpose, a special training stand was developed which, with the help of electronic modulating devices, has permitted real measurements to be conducted which would correspond with measurements made

during an actual flight. The activities of the pilot corresponded to the actual flight activities. The possibility of imitating the unusual (emergency) variants of flight and training of the activities of the astronaut during such crash situations was assured.

The principal assignment of investigations during the long periods in specially equipped sound-proof chambers was to determine the nervous psychological stability of the cosmonaut during his long stay in isolated space in close quarters in conjunction with a considerable decrease of external stimulation. A day regime and conditions for feeding were created, which were approximate to the conditions which would take place during a real flight.

A great number of physiological investigations and also special psychological-physiological methods has permitted the selection of persons who had better characteristics of accuracy, clearer accomplishment of problems, and a more stable nervous-emotional sphere.

During tests on centifuges and heat chambers, the individual endurance by cosmonauts of the corresponding effects was determined. The influence of these effects on the course of the basic physiological functions was studied, and the problems of increased stability of the organisms to the created factors from the external environment were solved. As a result of these investigations, it was established that the cosmonauts possess a good stability toward the effects of the above-named factors, and the selected persons withstood the tests better than the others.

In the process of parachute training, each cosmonaut completed several dozen jumps. Physical training of the group of cosmonauts consisted of planned exercises and morning gymnastics.

The planned exercises were conducted with the consideration of individual characteristics of the physical development of each of the cosmonauts. The morning exercises were conducted for one hour daily and their purpose was general physical preparedness. The physical exercises were directed toward the increase of stability of the organism toward the effect of acceleration, the cultivation of experience in the free control of a body in space, and the increase of the capability to endure extended physical tensions.

Physical training was conducted under a constant medical observation and has included specially selected gymnastic exercises, games, water diving, swimming, and exercises on special devices.

After the completion of the program of special training, a direct preparation toward the forthcoming cosmic flight was organized. This preparation consisted of the following:

- 1. The study of flight assignments, chart of the area of landing, piloting instructions, conduction of radio communication, etc.;
- 2. The study of the emergency kit, its utilization at the point of emergency landing, the study of the direction finding system, etc.;
- 3. Tests on the centrifuge in a space suit at maximum magnitudes of anticipated gforces;
- 4. Long-lasting tests in a mock-up type spaceship with the utilization of all systems of life preservation.

As a result of the conducted trainings, a group of cosmonauts was selected who were prepared and ready for a flight into cosmic space.

From that group of cosmonauts, the pilot Major Youri Gagarin was selected for the first flight into space by a man.

This outstanding Soviet man, Youri Gagarin, was born on March 9, 1934, into a family of collective farmers. His long-lasting dream was to become a pilot. After graduation from the Orenburg Aviation School in 1957, and after obtaining the speciality of a military fighter pilot, Youri Gagarin served in one of the sectors of the armed forces of the Soviet Union. By his own request, he was taken into consideration as a candidate for a cosmonaut and he successfully passed the selection. During the preparation of a group of cosmonauts, Youri Gagarin was one of the best candidates.

THE FIRST COSMIC FLIGHT

The launching of the spaceship "Vostok" took place on April 12, 1961, at 9:07 a.m., Moscow time.

During the duration of the entire acceleration sector of flight, the pilot cosmonaut Youri Gagarin maintained a continuous radio-telephone communication with the ground center which conducted the flight. The state of being of the cosmonaut during that sector of flight was very satisfactory. He noted the changes in gravitation and the moments of separation of the stages of the carrier rocket very accurately. The noise inside the cabin of the spaceship did not exceed the noise in the cockpit of a jet plane. During the acceleration sector, Youri Gagarin observed the Earth through the illuminator.

The control of the operation of the instruments aboard the spaceship during the flight in orbit, and the orientation and descent of the spaceship was carried out

automatically. However, in case of necessity, the cosmonaut could have, by his own wish or by command from Earth, taken the controls of the spaceship into his hands, determine his position, and carry out the descent and landing in the preselected region.

After the injection into orbit, the state of weightlessness began. In the beginning, this state was very unusual for the cosmonaut, but very soon he became accustomed to it. The state of being of Youri Gagarin during the entire duration of weightlessness was very good; his work capability was completely preserved.

In correspondence with the assignment and the flight program, Gagarin followed the operation of the instruments aboard the spaceship, he maintained a continuous telephone and telegraph radio communication with the Earth, he conducted observations through the illuminator and the optical orientator, he reported to Earth and recorded data of observations in his log book as well as on a tape recorder, and he ate and drank.

The Earth's surface was clearly visible from an altitude of 300 km. Gagarin could see very sharply the shoreline, large rivers, the relief of the Earth's surface, large forests, clouds and their shadows on the Earth. During the flight over the territory of our country, Youri Gagarin could observe the large fields of our collective farms.

The sky was entirely black. The stars on the background of the sky seemed to be brighter and sharper than as seen from the Earth. The Earth is surrounded by a very beautiful blue halo. The colors on the horizon change from light blue, to blue, deep blue, violet, and finally black. During the exit from the shadow near the horizon of the Earth, a bright orange coloring appears, which then passes on to all colors of a rainbow.

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At 9:51 a.m., Moscow time, the automatic system of orientation of the spaceship was activated. After leaving the shadow, this system carried out its seeking operation and the ship was oriented on the Sun.

At 9:52 a.m., Moscow time, the cosmonaut Youri Gagarin, who was then flying over the area of Cape Horn, transmitted one of his reports about his well being and the normal operation of the instruments aboard.

At 10:15 a.m., Moscow time, from the automatic programming device came the command for the preparation of the instruments aboard toward the activation of the braking motor. At that moment, the spaceship was flying toward Africa, and Youri Gagarin transmitted his successive report about the flight.

At 10:25 a.m., Moscow time, the braking motor was activated and the spaceship transferred from the orbit of an Earth satellite to a descent trajectory.

At 10:35 a.m., Moscow time, the spaceship began to enter the dense layers of our atmosphere. After completing the first cosmic flight in history with a cosmonaut aboard, the spaceship "Vostok" landed at a preselected area at 10:55 a.m., Moscow time. After his return from that cosmic flight, the pilot cosmonaut Youri Gagarin is in very good shape. No disturbances in the state of his health and mind were detected.

The first flight in history into cosmic space, which was accomplished by a Soviet cosmonaut Youri Gagarin aboard a spaceship-satellite "Vostok", has made it possible to draw the conclusion of great scientific value about the practical possibility of manned flights into space. This flight has proven that man can normally endure conditions of cosmic flights, acceleration, and injection into an orbit and of return to Earth. This flight has proven that conditions of weightlessness do not affect a man's capability to maintain his work capability, coordination of movements, and sharpness of mind.

The flight has yielded extraordinarily valuable information on the operation of the structure and equipment of the cosmic ship during the flight. The correctness of our scientific and technical solutions which were included in the spaceships construction were fully confirmed. The reliability of the carrier rocket and the constructive perfectness of the spaceship-satellite were confirmed.

From now on, we are in possession of the means for flights of a man into space.

The first flight of a man into space opens a new cosmic era in the history of mankind.

The time has come for the practical realization of projects which seemed to be fantastic up till now, the time for the creation of extraterestrial scientific stations-observatories, cosmic trips of man to the Moon, Mars, Venus, and other planets of the solar systems.

The new cosmic era in the history of mankind is the era of collosal increase in the sphere of life and activity of mankind, the era of conquest by man of the near-solar cosmic space.

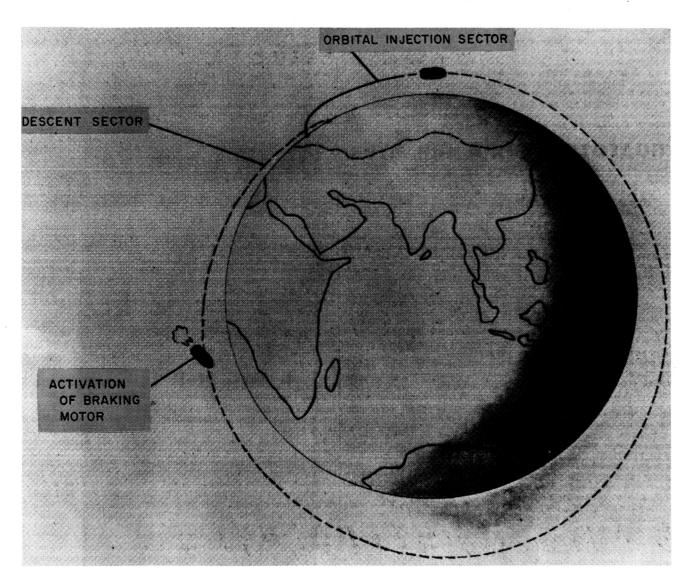


Fig. 1. Orbit path of spaceship-satellite Vostok

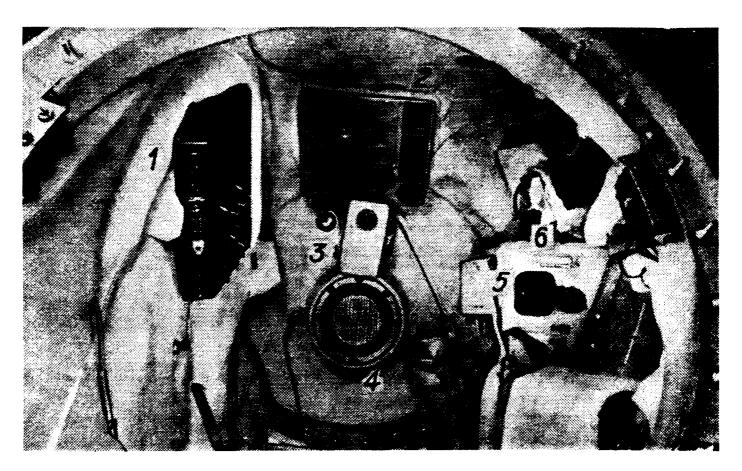


Fig. 2. Inside view of astronaut Gagarin's cabin

- (1) Pilot's control panel
- (2) Instrument panel with synchronized globe
- (3) Television camera
- (4) Illuminator with reticle (optical orientator)

- (5) Manual flight control stick
- (6) Radio receiver
- (7) Food container



Fig. 3. Gagarin in space suit before flight